

## CUTANEOUS MANIFESTATIONS IN OBESE PEDIATRIC PATIENTS

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### ABSTRACT:

**Objective:** Obesity is an increasingly prevalent nutritional disorder in children worldwide. The literature mentions a wide number of skin conditions associated with obesity, such as striae, acanthosis nigricans, psoriasis, intertrigo, acrochordons, plantar hyperkeratosis, lymphedema, keratosis pilaris, adiposis dolorosa, hidradenitis suppurativa, as well as skin infections, such as tinea cruris, folliculitis, candidiasis, furunculosis and erythrasma. The present study is aiming to be a review of studies, a description of the most frequent obesity-associated dermatological complications in children and an understanding of the evidence and research describing the association between childhood obesity and skin diseases. **Materials and method:** This review summarizes the most relevant published studies (original papers and reviews) in the scientific literature that have been identified and critically analyzed with the electronic international indexed databases PubMed, Medline and Web of Science. The papers were searched with the following keywords: cutaneous manifestations, skin, pediatric, obesity, acanthosis nigricans, psoriasis. **Results:** The articles were studied and analyzed to be according to the subject. The cutaneous manifestations in children with obesity can be classified into 3 groups: modifications in skin physiology, skin changes associated with obesity and obesity-related skin disorders. **Discussions:** Obese pediatric patients have a variety of skin physiologic modifications, including the following: excessive sweating and dry skin, alteration of collagen structure and function, physiological folds, heat intolerance and localized rash in area of friction. The skin disorders associated with obesity are: Acanthosis nigricans, Acrochordons or fibroepitheliomas, Striae, Plantar hyperkeratosis. In the category skin disorders exacerbated, obesity is a well-established risk factor for psoriasis development, as stressed out by many studies. For obese patients with a variety of risk factors, infections (for example, intertrigo) are the most frequent complications. Acne is a chronic inflammatory skin condition with numerous psychosocial implications.

**Conclusions:** The prevalence of obesity and its associated comorbidities are rising in the population. Although the majority of the skin lesions linked to obesity have unknown causes, it has been found that obese children have a higher prevalence of these lesions. Understanding the significance of obesity and the risk factors associated with it may improve with early diagnosis, treatment, and prevention of its serious repercussions.

**Keywords:** cutaneous manifestations, skin, pediatric, obesity, acanthosis nigricans, psoriasis

### INTRODUCTION

Obesity is an increasingly prevalent nutritional disorder in children worldwide. Defined as a body mass index above the 95th percentile for children and teens of the same age and sex, as opposed to overweight (body mass index between the 85th percentile and the 95th percentile), obesity predisposes not only to cardio-vascular disease beyond

adolescence, but also to childhood onset type 2 diabetes mellitus, insulin resistance, hypertension, liver and renal disease and reproductive disorders. All pediatric age groups can be affected, but the disease is more likely to appear when hormonal and genetic imbalances are present, provided that other risk factors, such as poor eating habits and metabolic disturbances are missing.

Obese children suffer from several cutaneous conditions, as a response to abnormal sebaceous glands and sebum secretion, impaired collagen function and structure, diminished skin barrier function, macro and microcirculation defects. Literature mentions a wide number of skin conditions associated with obesity, such as striae, acanthosis nigricans, intertrigo, lymphedema, keratosis pilaris, acrochordons, plantar hyperkeratosis [1], adiposis dolorosa, hidradenitis suppurativa, psoriasis [2], as well as skin infections, such as tinea cruris, folliculitis, candidiasis, furunculosis and erythrasma [3]. Other authors expand this list with hidradenitis suppurativa, acne, hirsutism [4], xanthomas and corns [5].

While some studies do not offer a precise percentage of acanthosis nigricans association with obesity, others [5] describe this skin pathology in up to 49% of patients. The same authors list of psoriasis as a rare association with obesity, while assessing that acanthosis nigricans is more frequent in females. Gupta et al. [6] also found acanthosis nigricans in up to 42% of patients, especially those with class II obesity, while psoriasis was only encountered in one obese child.

The prevalence of acanthosis nigricans in adult obese patients seems to be even higher, up to 74%, and these patients often have insulin resistance too [7], as first described by Kahn in 1976 [8]. This is an important fact in children, as well, since the American Diabetes Association issued a warning in 2000 regarding the fact that acanthosis nigricans is a formal risk factor for childhood diabetes.

Psoriasis is another non-contagious skin condition that affects obese children, one thought to have a genetic predisposition. The disease is exacerbated by stressful events and is often characterized by remission and relapse periods. Extensor areas are frequently

affected, but other regions, such as the scalp, umbilicus, retro-auricular and lumbosacral areas and intergluteal clefts may be affected. Lesions progress from macules to desquamative plaques [9].

Psoriasis starts in 15% of cases before 10 years and 35% before 20 years. The first symptoms occur during childhood and adolescence up to 30% of patients. Although psoriasis lesions are rarer in children compared to adults, the psychosocial impact is much higher. Psoriasis begins during childhood in 22% to 33% of cases, especially during adolescence, and incidence in children has more than doubled since the early 1970s [10]. A study by Augustin et al. found the prevalence of psoriasis in children in Europe of to 0.71%. Also, they said that the prevalence of psoriasis increases with age during childhood [11]. The studies found that the incidence of psoriasis was higher in girls than in boys. The incidence of pediatric psoriasis doubled between 1970 and 2000, this being explained by an increase in risk factors for psoriasis, such as psychosocial stress, bacterial infections (30% of cases of psoriasis in children after rhino-pharyngeal infections), obesity, overweight [12].

The present study is aiming to be an review of studies, a description of the most frequent obesity-associated dermatological complications in children and an understanding of the evidence and research describing the association between childhood obesity and skin diseases.

## **MATERIAL AND METHODS**

This review summarizes the most relevant published studies (original papers and reviews) in the scientific literature that have been identified and critically analyzed. The search of scientific articles was made with the electronic international indexed databases PubMed, Medline and Web of Science. The papers published up to

December 2022 in each author's field of expertise were searched with the following keywords: cutaneous manifestations, skin, pediatric, obesity, acanthosis nigricans, psoriasis. In order to provide a theoretical perspective, all co-authors discussed and approved the final draft.

**RESULTS**

The analysis identified through databases a total of 313 articles that were studied and analyzed to be according to the subject, of which 10 articles were read entirely in final analysis. Also, a manual

search was done in the reference lists of the chosen papers as part of our analysis and two studies was omitted due to its abstract. In the end, 5 articles on the particular topic were included in this review.

The literature mentions a wide number of skin conditions associated with obesity. The cutaneous manifestations in children with obesity can be classified into 3 groups (tab. I): modifications in skin physiology, skin changes associated with obesity and obesity-related skin disorders [13].

Tab. I - Cutaneous manifestations in children with obesity

Physiological Modifications	Skin	Skin Disorders associated with Obesity	Skin Disorders exacerbated by Obesity
Dry skin Heat intolerance Excessive sweating Localized rash in areas of friction		Acanthosis nigricans Acrochordons or fibroepitheliomas Striae Plantar hyperkeratosis	Psoriasis Atopic dermatitis Skin infections a. Fungal b. Bacterial

Adapted after Torres B et al., [13]

**DISCUSSIONS**

**Physiological Skin Modifications**

Obese pediatric patients have a variety of skin physiologic modifications, including the following: excessive sweating and dry skin as a result of increased transepidermal water loss and altered barrier function [14], alteration of collagen structure and function; elevated lipokine activity and leptin resistance, likely as a result of an imbalance in adipocyte cytokine production; and the production of tumor necrosis factor- $\alpha$ , transforming growth factor- $\beta$ , interleukin (IL) 1, IL-6 and leptin, leading to a proinflammatory state [15]. Other physiological effects of obesity on skin include increased physiological folds, heat intolerance and localized rash in area of friction.

**Skin Disorders associated with Obesity**

Acanthosis nigricans is a condition that affects individuals with severe obesity and is characterized by hyperpigmented, velvety and sometimes localized cutaneous thickening of the skin [16]. The neck, skin folds, armpits and hand knuckles are the places where it is mostly found. The most typical initial symptom seen in children with obesity and/or insulin resistance syndrome is acanthosis nigricans. Treatment usually entails reducing body weight and maintaining adequate blood sugar control [13]. Although acanthosis nigricans is regarded as an indication of insulin resistance, according to Hirschler V et al., they demonstrated that among obese teenagers, acanthosis was only associated with increasing obesity and not insulin resistance [17]. In contrast, it was discovered that obese adolescent girls with acanthosis nigricans had polycystic ovarian

syndrome as a symptom of insulin resistance [18].

Acanthosis nigricans can also develop in children with multisystemic disorders, which in these situations serves as a helpful diagnostic marker. This dermatologic manifestation can occur in 2 types of acanthosis nigricans: type A, also known as the HAIR-AN syndrome (hyperandrogenism, insulin resistance and acanthosis nigricans) and type B acanthosis nigricans, which is more prevalent in female and older patients. In type A hyperandrogenism is linked to polycystic ovaries, virilization signs, hirsutism, seborrhea and outbreaks of acne. Type B is accompanied by marked hyperandrogenism and other autoimmune illnesses, most notably lupus erythematosus [19]. Adult acanthosis nigricans may be associated with malignancy, but this is seldom the case in childhood. When facing an obese child with skin lesions that evoke this diagnosis, the clinician should first exclude a familial form of the disease and then check for an association with metabolic syndrome [20], since acanthosis nigricans seems to be a reliable early marker [21].

Acrochordons, fibroepithelial polyps or pedunculated fibroids are tiny growth structures, soft, coffee-colored, pedunculated papules that develop in folds like the armpits, neck and groin. Acrochordons are typically small, under one centimeter and they are thought to be the result of skin-on-skin friction. Usually, the condition is related to acanthosis nigricans [13,22]. On the prevalence of this pathology in children, few studies have been reported. Although the cause of these skin tags is unknown, on adult population is strongly associated with excessive skin rubbing, obesity, metabolic syndrome, hypertension, and hormonal imbalance. Cryotherapy, electrodesiccation,

or straightforward excision with cold scissors are all possible treatments [13].

Striae distensae, also known as stretch marks, are linear, white, atrophic plaques that are very common and appear on body parts that experience the most tension, such as the breasts, buttocks, belly, and thighs [23]. In childhood, striae is directly related to excess weight [24] and the prevalence reported in the adolescent population ranges from 6 to 86% [25]. The exact cause of striae is unknown, however given that they frequently appear on areas that are under tension, the mechanical expansion of the subcutaneous tissue caused by fat deposits is thought to be the primary etiology [23]. The stretch marks in the initial stages are erythematous, but they later became violet and in final stages are white depressed patches [13]. The hormonal factors, such as increased expression of estrogen receptors, androgen receptors, and glucocorticoid receptors, as well as the reduced expression of procollagen and fibronectin genes as well as changed skin structure all contribute to the development of striae distensae [23].

Plantar hyperkeratosis represents a disease brought on by physical pressure mechanisms related with the duration and severity of obesity [24]. The shape of the foot may change in obese people with the loss of the arch, a broader and more noticeable footprint, caused by increased pressure that is visible when the patient is standing or walking [26]. In patients with diabetes mellitus, plantar hyperkeratosis is a precursor lesion to diabetic foot [27].

#### **Skin Disorders exacerbated by Obesity**

Obesity is a well-established risk factor for psoriasis development, as stressed out by many studies [28, 29, 30]. Furthermore, the lesion tends to be more severe as the body mass index increases for the same patient [31]. A vicious circle may be

described here, since psoriasis is a Th-1 inflammatory disease, and chronic Th-1 inflammation is a key feature of obesity, insulin resistance, diabetes, hyperlipidemia [32] and metabolic syndrome [33]. The directionality of the cause-effect relationship is uncertain here, since some studies state obesity causes psoriasis [28] and some declare the opposite [34]. In any case, interdependence between these diseases is well established and aggravation of one leads to exacerbation of the other [35].

The child's psoriasis may occur in the following aspects, even if they have the same subtypes of psoriasis that we diagnose in adults: facies psoriasis (more commonly in children compared to adults), spinulosic psoriasis (follicular keratosis in flexion areas), palmar-plantar psoriasis, erythrodermic psoriasis (rarely encountered and requires differentiation with non-bullous erythroderma) and newborn psoriasis that can be confused with diaper dermatitis. Psoriatic rash occurs under 2 years of age and is characterized by erythematous plaques, well defined in the diaper area, which can affect the inguinal folds and can be difficult to treat. Erythrodermic is one of the most severe types of psoriasis, but is extremely rare in children. Is characterized by erythema over a large part of the body, with or without exfoliation, edema, intense pain, hair loss. Unfortunately, these patients have an unfavorable prognosis because complications (hypothermia, hypoalbuminemia and cardiac failure) may occur early [36].

In childhood, the typical plaques are erythemato-squamous, well defined, generally asymptomatic, but sometimes patients can accuse local pruritus. Psoriasis lesions tend to develop more often on flexion areas, but the papules and plaque psoriasis may develop in any area skin and are usually distributed symmetrically [37]. Rarely mucosa may be affected in children with

psoriasis. The scalp is the most frequently involved area and often the first place of presentation in children. Another form of psoriasis common to pediatric age is guttate psoriasis, which consists in the appearance of an erythemato-squamous eruption of several millimeters at the trunk, usually after about 10-14 days after an infection with  $\beta$ -hemolytic streptococcal or viral infection. Guttate psoriasis has a self-limiting character, lesions disappear after 3-4 months but some patients have an increased risk to develop plaque psoriasis [38]. Although the positive diagnosis can be established based on the clinical aspect, in children with atypical forms, the biopsy can be done to confirm.

Diagnosis of psoriasis in obese children and adolescents is associated with abnormalities in blood lipid levels, hypertension, diabetes and high cardiovascular risk. Waist circumference percentiles are directly related to the severity of psoriasis lesions. Given the effects of cardiovascular complications, it is crucial that primary care physicians and pediatricians identifies and manages the cardiovascular risk factors in first stages in children so that it leads to an opportunity to prevent future cardiovascular events [39]. Zamboni showed that patients with psoriasis consumed more saturated fat, compared to people without psoriasis [40].

Atopic dermatitis, obesity, and bronchial asthma are strongly associated, particularly in obese children under the age of five who have prolonged condition [41]. Given the potential for commencement as early as the first few months of life and the disease's variable development with alternating periods of exacerbation and remission, the clinical features are complicated. For the purposes of prevention, diagnosis, and focused therapy approaches, atopic dermatitis must be viewed as a

systemic disease rather than just a dermatological one [42].

For obese patients with a variety of risk factors, infections are the most frequent complications. Intertrigo is the most typical manifestation and is characterized by noticeable redness in the body folds, often accompanied with discharge and occasionally odor. Topical antibiotic therapy is the treatment necessary for this condition. Infection with *Candida albicans* is a common complication in intertrigo that necessitates extra topical antifungal treatment [13].

Other infections exacerbated by obesity are pachyonychia, furunculosis, and anthrax caused by staphylococci, as well as erythrasma caused by *Corynebacterium minutisimi*. Additionally, due to lymphedema and venous insufficiency, obese patients have a higher risk of developing vascular ulcers and cellulitis in the extremities [13].

Acne is a chronic inflammatory skin condition with numerous psychosocial implications for patients. Comedones, which are noninflammatory, are formed as a result of the obstruction of pilosebaceous units, followed by papules, pustules, nodules, and cysts which are inflammatory [43]. According to age, there are five categories of acne in childhood: neonatal, infantile, mid-childhood, preadolescent, and adolescent. 20% of infants younger than six weeks old experience neonatal acne, which goes away around four months and is rarely treated with medicine [44].

Puberty frequently results in acne, which is thought to be an aberrant response

to normal testosterone levels and typically, the face, neck, shoulders, and upper back are affected. [45]. In a multicenter research, obesity was found to be highly (65%) correlated with acne in children [46]. However, in pubertal adolescent girls, insulin resistance, obesity, acanthosis nigricans, hirsutism, seborrhea, androgenic alopecia, all of which are symptoms of polycystic ovarian syndrome, may also be linked to acne [47]. For individuals with an obesity diagnosis, quality of life and psychosocial concerns are crucial factors. Children and adolescents with obesity and a skin disease should receive psychotherapy as part of their treatment since discrimination against obese persons is a serious social issue that needs to be addressed at an early age [48].

## CONCLUSIONS

The prevalence of obesity and its associated comorbidities are rising in the population. To ensure early diagnosis, avoid sequelae, and deepen our understanding of both old and new correlations in this context, pediatricians need to be aware of the cutaneous symptoms of these conditions. Although the majority of the skin lesions linked to obesity have unknown causes, it has been found that obese children have a higher prevalence of these lesions. Understanding the significance of obesity and the risk factors associated with it may improve with early diagnosis, treatment, and prevention of its serious repercussions.

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